Physics & Philosophy

Split, 7–8 July 2014

Organizing and Program Committee

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2014

Program

The Third Meeting PHYSICS & PHILOSOPHY takes place at the Faculty of Humanities and Social Sciences University of Split, Teslina 12, Split. The time schedule will be flexible and it will depend on the length of the discussions.

Monday (July 7 2014)		
9:00–9:15	Opening	
9:15–11:00	Tim Maudlin	Galilean Relativity and the Lorentz Contraction
11:00–11:20	Coffee break	
11:20–12:40	Tomislav Živković	Space and Time in Quantum Theory
12:40–14:00	Dragan Poljak and Mirko Jakić	On the Nature and Development of the Scientific Method
14:00–16:00	Lunch break	
16:00–16:50	Nikola Tomašević	An Interpretation of Rational Numbers in Fuzzy Logic: Analysis of a Paper by Misha Koshelev and Vladik Kreinovich
16:50–17:40	Franjo Sokolić	Space, Time and Space-time: Substantivalism and Relationism
17:40–18:00	Coffee break	
18:00–18:40	Lovre Grisogono and Mateo Paulišić	A Few Good Examples why to Refute Classical Logic in Quantum Mechanics

Tuesday (July 8 2014)		
9:15–11:00	Detlef Dürr	Φ&Φ
11:00–11:20	Coffee break	
11:20–12:40	Slobodan Bosanac	“Unsolved problems” in Physics?
12:40–14:00	Dubravko Horvat and Zoran Narančić	Mach’s Principle and Extended Theories of Gravity
14:00–16:00…	Lunch	
16:00–16:50	Peter Lukan	The Relevance of Interpretation of Probability for Modern Physics
16:50–17:40	Luka Boršić and Ivana Skuhala Karasman	What was (Scientific) Method before Galileo?
17:40–18:00	Coffee break	
18:00–19:00	Berislav Žarnić	Disjunctive Facts and Superposition of States
19:00–19:20	Closing	

Abstracts

Galilean Relativity and the Lorentz Contraction

Tim Maudlin
New York University

It is often said that one of the fundamental principles of both classical physics and Relativity is Galilean relativity or the equivalence of all inertial frames. I will discuss the precise phenomenon that Galileo remarked in On The Two Chief World Systems, and the relation of that phenomenon to both coordinate transformations and to symmetries of space-time. This yields two different ways to address the question of whether the Lorentz contraction in Relativity is a physical effect.

Space and Time in Quantum Theory

Tomislav Živković
Institute Ruđer Bošković, Zagreb

Symmetry principles contained in the Euclidean group of transformations (translations and rotations) produce a classical notion of a three-dimensional space. This space is almost automatically, without any further analyse or justification, applied to quantum theory. However, detailed analyse of the formalism of quantum theory shows that those very same principles allow for a huge number of additional transformations which are not possible in a classical approach. Each such additional transformation determines a transition to some new "quantum" reference frame. Classical three-dimensional space hence generalises to a quantum space which contains all such reference frames. Essential property of those quantum transformations is that they dissolve the notion of a "point". In a classical theory the point is a primitive indestructible element of space, and the point in one reference frame is the point in all other reference frames. This is not true in quantum theory. An infinite number of reference frames which in classical approach allow for the same description of physical reality is in quantum theory generalized to an infinite number of "classical" spaces which are all isomorphic to the Euclidean three-dimensional space and in each of those spaces the laws of quantum theory are the same. The points contained in one of those spaces are in other spaces in general delocalised and occupy some finite or even some infinite volume. The notion of a particle trajectory hence loses its absolute meaning. All attempts to reformulate quantum theory in terms of some hidden variables are hence obsolete.
Symmetry principles contained in the Poincare group applied to quantum theory produce similar results. Instead of a single space Minkowski one finds a multitude of such

spaces and all those spaces are mutually interlaced. The notion of a four-dimensional event accordingly generalises, and this applies to its space as well as to its time component. In particular, classical notion of a moment of time (which is associated to a definite position in space) in quantum theory loses its absolute meaning and the moment of time in one reference frame can appear as some period of time in another reference frame.

Five Roads to the Second Law

Milan Ćirković[1] **and Jelena Dimitrijević**[2]
[1] *Astronomical Observatory of Belgrade, Belgrade, Serbia; Future of Humanity Institute, Faculty of Philosophy, University of Oxford,* [2] *Faculty of Philosophy, University of Belgrade*

Paper presented by title

We are witnessing a resurgence of interest in the problem of the origin of the thermodynamical arrow of time (a.k.a. the origin of the Second Law of thermodynamics or the entropy gradient or the thermodynamical temporal asymmetry, etc.). Although variations on the same theme existed since antiquity, the problem in its modern form was probably first formulated by Irish physicist Edward P. Culverwell in 1890, who concluded that the kinetic theory alone could never succeed in explaining the second law of thermodynamics. This has provoked Boltzmann (and Schuetz) to formulate one of the most interesting answers to the puzzle, an answer which, we hereby attempt to show, has remained interesting, in a particular reformulation, to this day. Before engaging in such reformulation, we present a modern taxonomy of the approaches to the explanation of the thermodynamical arrow of time. There are five possible roads to be taken, depending on the exact location of the origin of the asymmetry and the nature of physical mechanisms involved: two inherent solutions (statistical and dynamical), interventionism, Acausal-Particular approach of Price, and the reformulated Boltzmann-Schuetz mechanism. Surprisingly enough, it seems that most solutions include at least some new physics, on either micro- or macro-level. The preferred alternative (which we dub the Acausal-Anthropic approach) is based on accepting Boltzmann's statistical measure at its face value, and accomodating it within the multiverse concept. Notably, the special low-entropy initial conditions of our cosmological domain ("universe") are best explained by embedding them in a wide spectrum of many possible initial conditions appearing among $O(10^{100})$ low-energy domains of the M-theory multiverse.

On the Nature and Development of the Scientific Method

Dragan Poljak[1] and Mirko Jakić[2]
[1] *Faculty of Electric Engineering, Mechanical Engineering and Naval Architecture, University of Split,*
[2] *Department of Philosophy, Faculty of Humanities and Social Sciences, University of Split*

The paper deals with some historical and philosophical aspects of the emergence and development of the scientific method. First, the very definition of the scientific method is given and then the birth of the method initiated with Galileo's experimental work and the Bacon's induction is discussed. The paper then continues with the Newton's mechanics, his emphactio in distans concept, his idea of absolute space and time and Leibniz critics of Newton approach. What comes next is development of thermodynamics and electromagnetism featuring the notion of classical field and abandoning of actio in distans concept. This is followed by the philosophical insight beyond the theory of relativity and the quantum physics.
Finally, some essential relations between philosophy and science are stressed out. Also, possible limitations of the scientific method are underlined.

Niels Bohr's Complementarity: The Experimentalist Method And The Experimental Phenomena Behind It

Slobodan Perović
Department of Philosophy, University of Belgrade

Paper presented by title

I identify a strong undercurrent of Baconian method of induction in Niels Bohrfhs work that likely emerged during his experimental training and practice. When its development is analyzed in light of Baconian induction, complementarity emerges as a levelheaded rather than a controversial account. It is carefully elicited from a comprehensive grasp of the available experimental basis, shunning hasty metaphysically motivated generalizations based on partial experimental evidence. I explore the nature of experimental phenomena that enables such a method to be successful.

Space, Time and Space-time: Substantivalism and Relationism

Franjo Sokolić
Faculty of Science, University of Split

Space and time, do they really exist or do they represent only some relations between material bodies? These are the questions appearing in the famous Clarke fh Leibniz correspondence, where Clark represented Newtonfhs positions. Although this dispute had its revival with Mach and Einstein, and again in the end of the XX century, it does not have a definitive answer. Is it a physical or philosophical problem?

A Few Good Examples why to Refute Classical Logic in Quantum Mechanics

Lovre Grisogono[1] and Mateo Paulišić[2]
[1,2] *Faculty of Science, University of Zagreb*

In this talk we shall present a few formal examples which will demonstrate how some classical logical properties fail when confronted with quantum mechanics. We will analyze classical properties such as commutativity and distributivity. First we will show the connection between logic and quantum mechanics in the way it is presented in Adler's and Wirth's article 'Quantum logic' [Adler, C. G., Wirth, J. F. Quantum Logic. In *American Journal of Physics* 51(5): 1983, pp. 412-417.], and the examples will be taken from that article. An example from Putnam's 'Is Logic Empirical?' [Putnam, H. Is Logic Empirical? In *Boston Studies in the Philosophy of Science* 5, R. S. Cohen, M. W. Wartofsky, ur. Dodrecht: D. Reidel, 1968, pp. 174-197.] will be the last one presented.

An Interpretation of Rational Numbers in Fuzzy Logic: Analysis of a Paper by Misha Koshelev and Vladik Kreinovich

Nikola Tomašević
Faculty of Science, University of Zagreb

One of the main problems of fuzzy logic is the interpretation of its values, which are to some extent arbitrary. The aim of the analyzed paper is to show how this problem can be avoided by using only fuzzy logic expressions. In particular, it is shown that any rational number can be interpreted with fuzzy logic.

Φ and Φ

Detlef Dürr
Mathematisches Institut Ludwig Maximilians Universität München

I shall explain what the title means using Bohmian Mechanics. In it lies the heart of the quantum formalism, operator observables and all that.

"Unsolved problems" in physics?

Slobodan Danko Bosanac
Institute Ruđer Bošković, Zagreb

One thinks that all problems in physics are solved, except that there is only the one of "Grand Unification". First, there are problems that are not truly solvable, but there are also those that are not so but only superficially. The latter are so because of not properly defined initial conditions, but not the improper use of dynamics equations. In the talk few examples of these "unsolved problems" shall be discussed, with the question in the end "Are we at the end of physics?".

Mach's Principle and Extended Theories of Gravity

Dubravko Horvat and Zoran Narančić
Faculty of Electrical Engineering and Computing (FER), University of Zagreb

Mach's principle is regarded as one of the milestones which guided Einstein to his General Theory of Relativity (GTR). For theories of gravity which go beyond GTR and which will be called here extended theories of gravity (ETG) the Mach principle may play the same role. Here an elementary presentation of the Mach principle is given with some of the philosophical issues concerning absolute space, relative motion, inertial forces and structure of spacetime. Extended theories of gravity will be sketched for the case where curvature R is replaced by torsion T and the role of the Mach principle for matter-geometry coupling will be explained.

The Relevance of Interpretation of Probability for Modern Physics

Peter Lukan
Faculty of Arts, University of Ljubljana

I will discuss the role of statistics and probability in the formation of some modern physical concepts. My aim is to show how the gradual progress of statistical and probabilistic thinking within physics, from the theory of errors on to the kinetic theory of gasses and atomism, enforced some existing concepts and introduced some new ones that had a major impact in the turn from classical to modern physics. This resulted also in the notion of statistical laws. I will point some problems in the interpretation of quantum mechanics that have roots already in classical statistical and probability theory. By doing this I want to argue for the need of interpretation of probability in order to make a step toward the reconciliation of the quantum and classical world.

What was (Scientific) Method before Galileo?

Luka Boršić[1] and Ivana Skuhala Karasman[2]
[1,2] *Institute of Philosophy, Zagreb*

We are going to present some significant struggles around the term "method" (*methodus*) in the late 16th century, i.e., the period immediately preceding Galileo Galilei. The authors we will be dealing with include: P. Pomponazzi, F. Patrizi, J. Zabarella, F. Piccolomini, B. Peireius, and J. Mazzoni. The overview of these authors' "methodological" considerations will reveal weaknesses in still prominent Cassirer's and Randall's thesis according to which Galileo's new methodology is solely a product of continuous evolution of the concept of scientific method from certain germinal ideas in Aristotle and Galen.

Disjunctive Facts and Superposition of States

Berislav Žarnić
Faculty of Humanities and Social Sciences, University of Split

Let us denote by '$\mathsf{descriptum}(p \sqcup q)$' the unobservable state of affairs described by the 'quantum disjunction' of basic physical propositions p and q describing mutually exclusive ('orthogonal') observable states. No such disjunctively composed state of affairs is allowed by *Tractarian* postulate of unique mode of composition of states of affairs. Quite the opposite holds true in the (orthodox interpretation of) quantum mechanics: mutually exclusive states of affairs are allowed to co-exist. If co-existence of orthogonal states is admitted, then a different kind of picture relation must be introduced to account for the possibility of describing this kind of reality. Some aspects of this new logico-metaphysical will be discussed.